



# The Big Picture – trends, drivers, wild cards, discontinuities and weak signals

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## ABSTRACT

Following work done in the UK, Canada and now starting across Europe,<sup>1</sup> there appears to be renewed interest in charting the boundaries of what to expect between 2010 and 2025 as the character of the 21st century begins to become firmly established. What are the shaping forces, or sources of change and what might be their impacts, particularly where these may create entirely new challenges and opportunities?

Futures experts (attendees of the FTA 2008 Conference) were invited to state their opinions on these questions by considering the trends, drivers, wild cards, discontinuities and weak signals likely to shape the future through the Big Picture Survey. The survey was launched 6 months prior to the Conference. More than 250 responses were submitted by the Conference date. The results collected were synthesised and presented back to the attendees in a plenary presentation by the authors.

The current paper aims to clarify the concepts first by suggesting definitions and discussing the distinctions between them. The paper then presents the rationales of conducting the Big Picture Survey (BPS), presents its methodology and discusses the results of the survey in a greater extent.

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## 1. Introduction

One of the recurring items of feedback from previous FTA Symposia and Conferences was the concern expressed by some attendees that an opportunity was being missed to use the assembly of strategic Foresight experts to gain more insights into the state of Foresight content regarding critical issues and trends, drivers of change and prospective discontinuities that might be expected within 5–10 or 15 years.

The rationale for this concern tended to be expressed in these terms: “At these meetings you have assembled many of the global experts in designing, managing and interpreting the outcomes of Foresight exercises that involve leaders from a diverse range of governments, universities and business enterprises – would it not be a useful addition to benefit from this expertise by developing a focused strategic discussion based around their experiences – i.e. what they are seeing as emerging critical forces causing change and what they are hearing or learning about the types of major changes or discontinuities that may be expected in the short, medium and long term.”

This Big Picture Survey (BPS) was designed primarily to address this concern. It has been structured to allow the Conference attendees, mainly the organizers and practitioners of Foresight, an opportunity to contribute to a value-adding

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<sup>1</sup> UK Ministry of Defence, UK Foresight Office Horizon Scan; Global Futures Forum Vancouver April 2008, Europe @ 2025 European Commission.

Foresight knowledge base regarding the directions and catalysts that are prompting our global future and its various contingencies and uncertainties. The originators of this survey used the responses to lead a plenary discussion at the 2008 FTA Conference, by providing some basic profile information without any attribution of responses to individuals. The BPS methodology was straightforward: an open-ended survey with compilation, grouping responses, and a general analysis of the five areas. We were more interested in the distribution of responses than individual response patterns. For this purpose, looking at the survey results we suggested a STEEP (Social-Cultural, Science & Technology, Energy, Ecology and Economy, and Geo-Politics) framework to map the five areas consistently. This allowed us to see the general patterns of preferences while still capturing the respondents' narratives.

The second section of the paper first clarifies the definitions of the concepts used including trends, drivers of change, wild cards/shocks, discontinuities, and weak signals. The review of the literature indicated that these concepts are not considered and compared in one single source. The current paper brings all these concepts together, suggests definitions for them and discusses the distinctions between them. Moreover, examples are provided to make the concepts clearer and to encourage reader to think about similar other Future-oriented examples from their own perspectives. Then, in the third section, the survey methodology and method of analysis are described. The fourth section presents the respondents' profile summary with a set of descriptive statistics including (i) the country of residence, (ii) Foresight experience, and (iii) principle affiliation/role. The results are analysed in greater detail in the fifth section. Subsequently, Section 4 discusses the implications of the findings on policy and strategy. Finally, Section 4 draws the overall conclusions and rounds off the paper.

## 2. Definitions of terminology

Trends, drivers of change, wild cards/shocks, discontinuities, and weak signals can be considered as the critical elements and essential outputs of Horizon Scanning.<sup>2</sup> The UK and the Netherlands have conducted their national horizon scans. In its Science and Innovation Investment Framework 2004–2014, the UK Government committed to establishing a Centre of Excellence in Horizon Scanning, to be based in the Foresight directorate of the Government Office for Science (see [www.foresight.gov.uk](http://www.foresight.gov.uk)). As another example, the Netherlands developed a joint horizon scanning procedure focused on security to identify their common strategic choices and questions for policy [1]. Work conducted within the scope of the European Foresight Monitoring Network (EFMN) included a strong element of scanning in the form of detecting and analysing emerging S&T issues [2].

Although a wide variety of definitions exist, the paper seeks to narrow the range of what is considered most applicable and thereby focuses on a single definition in each case after exploring several perspectives. This approach was selected because it was considered that a clear definition of the terms supported with examples would help the participants in completing the survey, particularly those with less Foresight experience, and also because it would distinguish the concepts from each other. Subsequently in conducting the survey it was nevertheless still evident that – at least perceptually on the part of many respondents – overlap exists, so it is deemed even more important to work toward a more commonly accepted set of definitions for purposes of future work in this area.

### 2.1. Trends

The starting point for scanning definitions is usually to identify the key trends which are presently evident in the broad sense of being both discernible and (usually are) somewhat gradual forces, factors and patterns that are pervasively causing change in society generally. The speed of change may be deemed comparatively slow or fast depending upon one's vantage point, but the important aspect of a trend is its pervasiveness.

These are representative of the broad forces and complex factors involving diverse actors that lead and cause societal change. What is often apparent is that most stakeholders are relatively powerless alone to affect the direction or intensity-impact of a trend so trends tend to display some dynamic – ecological characteristics, at least insofar as they usually endure as influential shapers for at least 4–5 years until succeeded by others. Some analysts have attempted to distinguish trends by their degree of influence [3].<sup>3</sup> It is also possible to further analyse trends according to their duration, scale, evolutionary pathways and structure (see the box below). However these degrees of differentiation, while clearly valid, were deemed too complicated for purposes of the survey.

#### **Mega-trends**

Trends come in different sizes. A mega-trend extends over many generations, and in cases of climate, mega-trends can cover periods prior to human existence. They describe complex interactions between many factors. The increase in population from the Palaeolithic period to the present provides an example.

<sup>2</sup> The UK Department for Environment, Food and Rural Affairs (DEFRA) defines Horizon Scanning as “the systematic examination of potential threats, opportunities and likely future developments which are at the margins of current thinking and planning. Horizon Scanning may explore novel and unexpected issues, as well as persistent problems or trends” (<http://horizonscanning.defra.gov.uk> – last visited on March 14, 2009).

<sup>3</sup> Strategic Trends “seek to identify and interpret the likely pattern of change” in the future ([3] p. xiii).

### Potential trends

Possible new trends grow from innovations, projects, beliefs or actions that have the potential to grow and eventually go mainstream in the future (for example: just a few years ago, alternative medicine remained an outcast from modern medicine. Now it has links with big business and has achieved a degree of respectability in some circles and even in the marketplace). See Damrongchai et al. [4] for an example of potential trends, being used in a technology roadmap.

### Branching trends

Very often, trends relate to one another the same way in which a tree-trunk relate to branches and twigs. For example, a well-documented movement toward equality between men and women might represent a branch trend. The trend toward minimizing differences in the relationship between the salaries of men and women in the Western world could form a twig on that branch [5].

As a result of the analysis, the current paper suggests the following definition of trends:

*Trends are those change factors that arise from broadly generalizable change and innovation. They are experienced by everyone and often in more or less the same contexts insofar as they create broad parameters for shifts in attitudes, policies and business focus over periods of several years that usually have global reach. What is interesting about trends is that normally most players, organizations or even nations cannot do much to change them – they are larger than the power of individual organizations and often nation states as well.*

The box below lists some examples of trends:

### Trend examples

- Aging population;
- Decline in state sovereignty;
- Islam-West cultural gaps;
- More nuclear equipped nations;
- Gradually increased concerns for the environment in terms of sustainability, human and animal health, and global warming;
- Increasing push for greater efficiency and decarbonisation of the energy system because of the environmental and energy security concerns;
- Shift to digital technology;
- Trend toward ever smaller, more mobile and more powerful computation-communications devices, and integration and convergence of functions and systems;
- Proliferation of nation states and groupings of peoples seeking self determination status.

## 2.2. Drivers of change

The second key definition concerns those forces, factors and uncertainties that are accessible by stakeholders and create or drive change within one's business or institutional environment. These tend to be more immediate and relevant and distinct to different types of stakeholders – and also they can be both adapted by and/or strongly impact stakeholders, sometimes rapidly.

### Driver of change examples

- Climate policies and resource practices;
- Major S&T developments and their societal impacts;
- Policy or regulatory changes that lead to changes in government priorities, company actions and investments;
- Demand for certain products or services changes and thereby shifts the marketplace, often in response to other drivers or trend impacts that finally become measurable in price terms, such as carbon credits, taxes and footprint accounting;
- Environmental policies and practices that are enacted to change behaviours and shift societal actions more toward integral or internalized measures – such as recycling requirements.

As one can see there are subtle differences from trends. Instead of being mid-longer term and quite pervasive, these concern areas, involve factors and forces that change from year to year and may be amenable to stakeholder actions and strategic choices by way of one's investments, new alignments, infrastructure, R&D, innovations and business-institutional strategies [6].

A critical concept associated with being a driver is the level of uncertainty. Drivers have real leverage on one's future flexibility and outcomes – i.e. if a driver goes one way or the opposite way the real divergence occurs and change patterns evolve differently. It has been said (by some practiced Foresight facilitators) that drivers are those critical choices, forks in the road and deep uncertainties that keep executives awake at night.

In this context, the definition for drivers of change was decided to focus on things that are accessible and directly impacting one's influence environment. Thus, drivers of change are *those factors, forces or events – developments which may be amenable to changes according to one's strategic choices, investments, R&D activities or foresight knowledge and strategies. They are both presently accessible and future relevant.*

The concept of uncertainty enters again into the Foresight process when for purposes of scenario planning there is an attempt to define the key drivers or those having both great uncertainty and potentially high impact. These are then structured into a matrix of 4 cells (2 drivers with high and low situations for each) or 8 cells (3 drivers) to create diverging scenario parameters, while trends are used to ask how each different scenario plays out against each trend and the other (less critical but still relevant) change drivers.

### 2.3. Wild cards or shocks

Because most people have experienced surprise situations and unforeseen developments that have in some way altered at least their expectations if not the direction of their existence, the concept of a wild card or shock is not that unfamiliar. In Foresight processes it becomes important to include some of these possibilities because they often do reshape the trajectories of events and situations. The real issue is how they should be contexted, and when and with what intensity they can or should be introduced. This is a key element of the art of crafting Foresight to respond well to plausible uncertainties and conceivable surprises, so for this survey it will not be possible to rigorously provide a single definition that fits all situations – so the following examples are useful to guide those seeking to imagine what could shock the systems of incremental change.

#### Wild card/shock examples

- Gulf Stream shift;
- Nuclear bomb;
- Fusion power;
- Cyber collapse;
- Human aging breakthrough;
- Solar flare, asteroid impacts, discovery of an alien;
- Autonomous computers;
- The attacks of September 11, 2001, which created significant shocks to the global security, airport screening and intelligence systems and practices;
- A major pandemic or outbreak of a human focused communicable disease that has not been prepared for – such as SARS, Bird flu and Swine flu;
- Another internationally relevant disruption of energy systems on the scale of a Chernobyl nuclear accident.

These examples suggest that wild cards involve relatively high impact but somewhat low probability events and situations that carry a lot of conditionality. They really are unlikely but if there is even a remote possibility, then that contingency needs to be accounted for.

The following description provides perhaps the most relevant definition for purposes of the current paper:

*Wild cards and shocks are those surprise events and situations which can happen but usually have a low probability of doing so – but if they do their impact is very high. These situations tend to alter the fundamentals, and create new trajectories which can then create a new basis for additional challenges and opportunities that most stakeholders may not have previously considered or prepared for.*

Arguably the best known work in wild cards comes from Petersen [7] author of “Out of The Blue – How to Anticipate Big Future Surprises”. Petersen's book articulates a series of events that due to their likelihood to surprise and potential for impact might be considered ‘Wildcards’. He defines wild cards as ‘Low Probability, High Impact events that, were they to occur, would severely impact the human condition’. Steinmueller [8] also has an excellent overview of wild cards in the 2008 RAHS Booklet on Foresight: Thinking about the Future.

Building on Petersen’s work, Barber [9] developed an additional wild cards tool called a “Reference Impact Grid” (RIG) which helps strategists and risk managers define vulnerabilities within a given system and to then consider what type of event might de-stabilise that system. Challenging Petersen’s hypothesis, his additional thoughts on ‘Cascading Discontinuity Sets’ broke away from the idea of wild cards to introduce other types of interrelated events. A Cascading Discontinuity Set can achieve a similar outcome to a one off Wildcard event but does so via a series of smaller, unplanned events that eventually overwhelm the system’s ability to cope. The idea is similar to the Black Swan theory described by Taleb [10] in his book “The Black Swan”. van Notten et al. [11] and Mendonça et al. [12] provide further discussion and examples on wild cards and shocks. Taleb [10] has also derived a series of principles for organizations – governments to try to avoid he kinds of disruptions that Black Swan events tend to cause.

Wild cards may also be introduced into anticipatory decision-making activity in order to increase the ability of social groups to adapt to surprises arising in turbulent business or social environments. Such sudden and unique incidents might constitute turning points in the evolution of a certain business – social trend or system.

A further clarification, thanks to the collective thinking of Wikipedia [5] is that wild cards may or may not be announced by weak signals, which are incomplete and fragmented data from which relevant Foresight information might be inferred. Sometimes, mistakenly, wild cards and weak signals are considered as synonyms, which they are not. There have also been attempts to link wild cards/shocks to trends (see the box below).

Trends	Wild cards
<b>Globalization</b> of markets: finance, goods & services, labor	Crash of global financial markets Globalization “with human face” Clash of civilizations
<b>Demography:</b> aging and shrinking of populations	A new baby boom “Breakdown of the sperm count” Clash of generations
<b>European Union:</b> enlargement and institution building	Europe orients to the East “Fraglargement” Fortress Europe
<b>Life styles:</b> erosion of traditional family	Return of family Spiritual revolution
<b>Technology:</b> rapid progress of ICT and biotech	End of Moore’s Law 100 years life expectancy
<b>Environment:</b> global warming, resources depletion	Collapse of the Gulf Stream Cold fusion energy

Source: Steinmueller [13].

#### 2.4. Discontinuities

Discontinuities refer to rapid and significant shifts in trajectories without the aspect of being mostly unanticipated or deeply surprising. They can take many forms such as ‘technological discontinuities’. According to at least one analyst [14], technological discontinuity is represented in a new technology or in the re-packaging of a set of existing technologies that result in quickly obsoleting a product or service. An example from the 1960s is the introduction of the electronic calculator. In a very short time, slide rules and mechanical calculators disappeared and, in some cases, the companies that made these products disappeared when they could not adapt to or find ways to use the new technology. Another more recent example is that of using the Internet and the tcp/ip protocol to transport voice calls. This application of the Internet represents a technological discontinuity for traditional telephone companies and provides an opportunity for small entrepreneurs to enter the telephone business with relatively little investment.

In general, the Internet and the Web represent technological discontinuities for many sectors and thus both create new opportunities and expose potential threats for those attached to old or inflexible technologies.

As just one example, as we train our reference librarians to do Internet reference using search engines, portals, and Web research guides we are finding less use of the Library of Congress classification system, a system which most students find obscure and confusing.

Another series of examples have recently emerged in the excellent work by Social Technologies, based in the USA. The following definition indicates how discontinuities are being positioned by them for Foresight purposes: “Discontinuities, which are those sudden, sharp breaks that can strike consumers, business sectors, nations, or the world with disruptive force. Exactly when, where, or how such events will occur is inherently hard to foresee” ([15], p. 2).

**Discontinuity examples**

- Google and Wiki, VOIP, Facebook and You Tube and similar innovations create powerful forces that change the business and social environments and personal information practices;

- Recent reports about accelerated arctic ice shelf melting and greenhouse gas concentrations in the atmosphere may create discontinuities in national and international policy approaches toward climate treaties design and promulgation;
- Advances in nanotechnology, genomics and quantum computing, if realised within the next decade, could fundamentally alter our ways of making materials, practicing medicine and computation-making calculations, with pervasive societal impacts.

The definition suggested by the authors of the current paper is as follows:

*Discontinuities are those situations – impacts where over time and extending beyond single events, change is rapid and fundamentally alters the previous pathways or expected direction of policies, events and planning regimes. While this is normal in most market places where the processes of creative destruction and products and services innovation are familiar, when discontinuities occur in society and government, the changes tend to be more significant because they can alter so many other domains.*

## 2.5. Weak signals

The final key term is “weak signals”. Weak signals are the first important indications of a change. These may be understood as advanced, somewhat noisy and generally socially situated indicators of change in trends and systems that constitute raw informational material for enabling anticipatory action. The benefits of weak signals can be seen when assessing their significance in an organization or a field concerned and analysing how the phenomena reflected by the weak signals should be reacted on.<sup>4</sup>

There remains some confusion about the definition of weak signal by various researchers and consultants. Sometimes it is referred as future oriented information, sometimes more like emerging issues. Hiltunen [16] has tried to clarify the confusion about the weak signal definitions, by combining signal, issue and interpretation in the concept of the “future sign”, which more holistically describes how these signals relate to change. Citing from Igor Ansoff, Hiltunen [16] provides a definition of weak signals as: “warnings (external or internal), events and developments that are still too incomplete to permit an accurate estimation of their impact and/or to determine their complete responses”.

Weak signals are meaningful as long as they are evaluated in the context of both their emergence and their evolution as a part of a pattern along with other weak signals. They do not exist in isolation.

Nevertheless weak signals do portend significance, even if the probability cannot be estimated easily, so for example, James Hanson’s presentation to the US Congress in 1988 about possible global warming on the horizon, or in technology terms, the speed of take up of “Mosaic” (precursor to Netscape) as the first Internet browser in 1993, were hard to estimate at the time, but can now clearly be seen as being indicative of things to come.

There are some tools for utilizing weak signals in organizational environments. One tool is called Strategy Signals, which aims to collect weak signals inside of an organization. The tool is developed by the Finnish company Fountain Park.<sup>5</sup> Another tool for using weak signals in organizations is called the Futures Windows [5], in which images of weak signals are shown in organization facilities. All the employees in the organization can send their images about weak signals to this tool. The purpose of that tool is to disseminate weak signals in organizations easily and increase futures thinking and innovating in the organization.

In general, weak signals are messages and signs usually associated with early developments in technologies, societal innovations, conflicts, origins of conflicts, etc. that while not easily verifiable from a present day perspective.

In conclusion regarding definitions, weak signals refer to *the early signs of possible but not confirmed changes that may later become more significant indicators of critical forces for development, threats, business and technical innovation. They represent the first signs of paradigm shifts, or future trends, drivers or discontinuities.*

### Weak signal examples

- In the 1980s the first mention was made of global warming and climate change;
- The collapse of the Berlin Wall and subsequently the Soviet Union was weakly discernible in the mid 1980s through assessments of military capacities and responses to the “Star Wars” initiatives;
- The growing importance of nanotechnology was first apparent as early as 1986 when Eric Drexler issued his first book on the subject.

<sup>4</sup> [http://www.metsaforumi.fi/dokumentit/newsletter3\\_05.pdf](http://www.metsaforumi.fi/dokumentit/newsletter3_05.pdf).

<sup>5</sup> <http://hosting.fountainpark.com/strategysignals/>.

### 3. Big Picture Survey

#### 3.1. Motivation and approach

Up until the Future-oriented Technology Analysis (FTA) 2008 Conference, previous FTA meetings tended to focus on methodology, policy linkages and success factors for Foresight design & delivery. The Scientific Committee of the FTA 2008 Conference heard that some attendees felt that an opportunity had been missed to discuss future Foresight determinants – i.e. content for Foresight structuring – with so many experienced experts. As a result, the Big Picture Survey was designed and implemented with the following key premises:

1. The FTA community is one of the most capable assemblies of strategic Foresight expertise, and would it not be useful to poll this group for Foresight insights?
2. Building on a survey of FTA Conference attendees-experts about critical trends, drivers, shocks-wildcards, discontinuities and weak signals, new insights can be gained about the state of Foresight and future uncertainties, which should be useful to the community.

##### 3.1.1. The structure of the survey

The survey consisted of two main parts. In the first part, the respondents were asked to provide descriptive information around three sorting variables:

1. Years of Foresight experience;
2. Country of residence;
3. Affiliation-type of organization represented.

Then, in the second part, the respondents were asked to identify a list of trends, drivers of change, wild cards/shocks, weak signals and discontinuities. The respondents were also asked to assess their entries by considering their:

1. Impact: rating of the trends, drivers, discontinuities as low, medium or high;
2. Likelihood: rating of the trends, drivers, discontinuities as low, medium or high;
3. Estimated time horizon: 2008–2015; 2016–2025; beyond 2025.

##### 3.1.2. Data set

- **Total surveys submitted: 293**; substantive completion: 106 (about 50% of FTA Conference attendees);
- **Respondent Distribution Charts** by: years of experience, country of residence and affiliation; (3)
- **15 STEEP Categories** for each domain of interest: i.e. trends, drivers, shocks, discontinuities and weak signals = 75 cells of content (Table 1);
- Qualitative review of Foresight (content) insights and patterns;

##### 3.1.3. Further analysis

- Analysis of each of the Domains of Interest according to % distribution by years of experience, country of residence, affiliation;
- Analysis of assessed impact, likelihood, controversy, time horizon patterns;
- Comparison of FTA community insights-domains content with others sources of Foresight trends, drivers, etc.

**Table 1**  
STEPP map for the Domains of Interest.

Sub-categories (A–B–C) to classify Domains of Interest			
1. Society & Culture	Social Norms, Education, Information & Knowledge Society	Demographics, Urbanization, Population Health & Migration	Equity, Ethical, Moral & Legal Issues
2. Science & Technology	Science Culture & Discoveries	Technology Progress	Innovative, Transformative Applications & Products
3. Energy	Current Energy Use, Peak Oil, Efficiency & Security	New and Renewable Sources	Non Renewable Energy Alternatives (e.g. H2, nukes)
4. Ecology-Economy	State of Global Finance, Trade, Debt and Related Globalization Issues	BRIC Rapid Development Economies	Climate Change, Global Warming = sustainable ecology, new economy
5. Geo-Politics & Security	East-West, North-South Issues, Governance, Health of Democracy, Failed States	Global, Cyber Terrorism & Nuclear & Bio WMD	Water, Food and Resource Shortages, Disasters

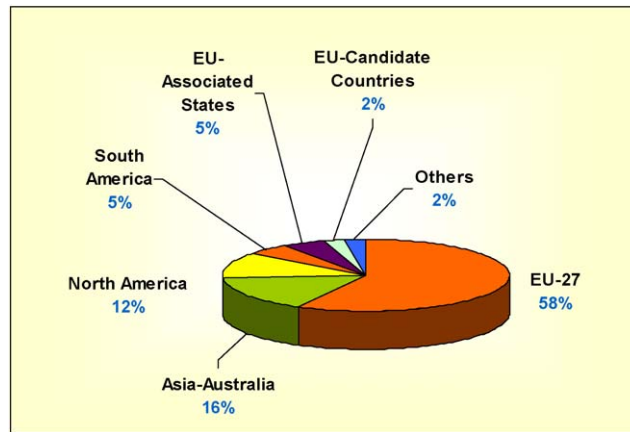


Fig. 1. Country of residence.

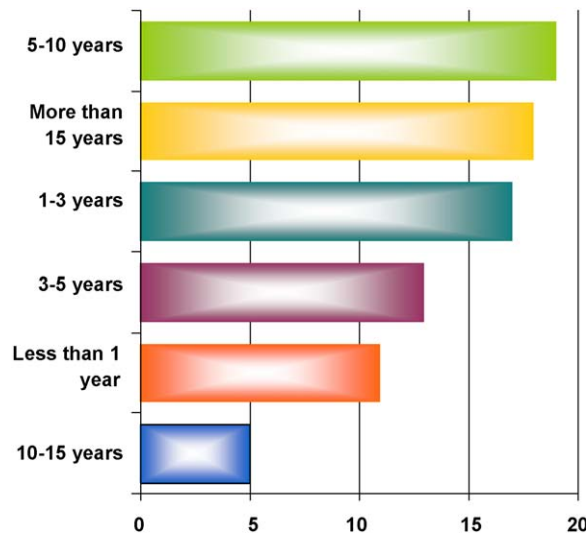


Fig. 2. Foresight experience.

- e.g. do those with more years of experience tend to use greater differentiation in their scoring?
- e.g. do academics or government respondents see the prospective developments in longer or shorter time horizons than the business respondents?
- Results can serve as baseline for a more quantitative-reactive survey next year – likely generating a higher return rate requiring less time to formulate original ideas.

### 3.2. Analysis of the results

#### 3.2.1. Descriptive statistics

This section presents the descriptive statistics of the participants.

**3.2.1.1. Respondents' profile summary.** Fig. 1 illustrates that the majority of the respondents were from the EU member states, with a considerable portion of respondents from Asia-Australia and North America.

The majority of respondents engaged in Foresight activity 5–10 years – as expected a quite experienced group of professionals (Fig. 2).

The survey respondents were mainly from Academia and Governmental bodies (Fig. 3).

#### 3.2.2. Analysis of trends, drivers of change, wild cards/shocks, discontinuities and weak signals

**3.2.2.1. Trends.** The trends obtained from the survey were mapped on the STEEP map for the Domains of Interest. Then the number of trends in each cell of the matrix was calculated. This gave the main orientations of the trends were represented with a radar diagram (Fig. 4).



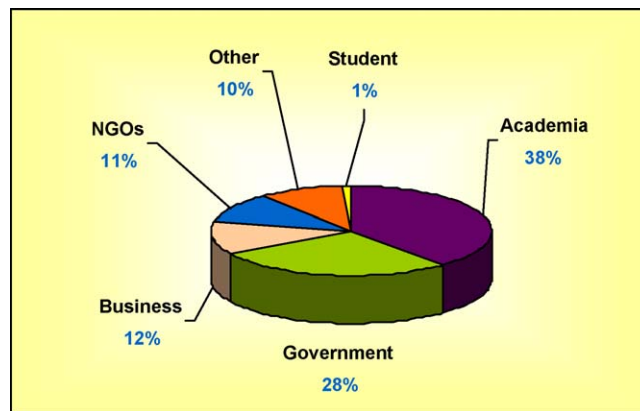


Fig. 3. Affiliation of respondents.

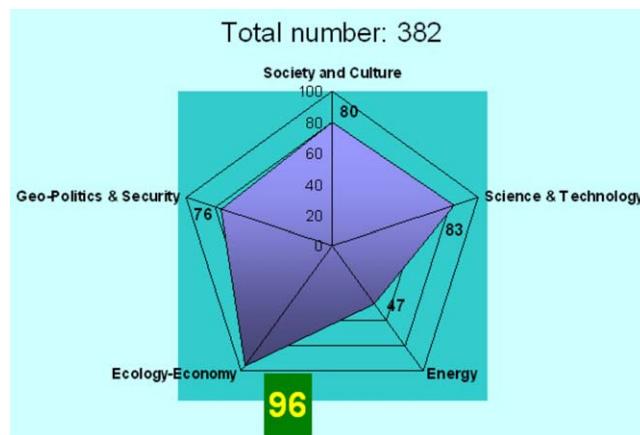


Fig. 4. Orientations of trends.

The diagram illustrates that:

- Contributors were inspired – 382 trends in total identified;
- STEEP format enabled three subcategories for each-for a total of 18 trend and driver categories: the analysis of trends indicated that the coverage was broad and quite deep as well;
- Balance was well distributed with economy-ecology leading but S&T, geo-politics, security and culture close behind;
- Many of these trends suggest substantial dislocations coming, involving disruptions and shifts to new premises for societal management, e.g. energy alternatives, resource shortages, bio-neural evolution, rising new economic leaders and directions, reduced personal privacy;
- These are described both in terms of challenges and potential opportunities for civilization.

Fig. 5 illustrates the frequency distribution of trends and the most widely cited ones.

Some of the most thought provoking trends are given in Table 2.

When both the frequency distribution (Fig. 5) and the highlights table (Table 2) are examined, it is rather clear that trends involving technology change and uncertainties about environmental, climatic and energy systems change are on the top of respondents minds. The general area of health system developments and changes is also prominent. Perhaps the most provocative ones are the trends describing broad new domains of human evolution (e.g. genetic manipulation, trans-humanism, “biologisation”, disruptive surveillance, etc.) which suggest new and quite different types of relationships within the human community and with the natural world. While clearly beyond the scope of this paper, it may be revealing to pursue some scenarios development that focus on tracking many of these possible provocative trends forward to try to estimate how disruptive they might conceivably be by 2025.

3.2.2.2. *Joint assessment of Foresight experience and trends.* The respondents with more than 15 years of experience constituted the largest single group, comprising more than a quarter of the total of all respondents – clear evidence of the substantial experience present at the FTA Conference. There was also a balanced representation from 1–3, 3–5 and 5–10

**Table 2**  
Examples of trends.

	Examples of trends by category		
	A	B	C
Society & Culture 66	Growth of knowledge/access and need for management “Privacy loss” as 21st century externality Dematerialisation the West/materialisation in the East	Aging/labor force ratio creating tensions Pandemic risks increase  Personalised medicine and home-based healthcare increase	Negative prospects from genetic manipulation Genetically designed children will be possible
Science & Tech. 77	More multi-disciplinary and e-science  Shortage of science in the West, growth of science in the East Growth of bio-sciences – “biologisation”	GM disease resistant plants and microbes for energy  Neural network functional drugs  New human species “Transhumanist evolution” – synthetic DNA, new drugs, prosthetic organs, etc. Growth of renewable energy: solar, wind, thermal, bio, ocean	Automatisation and robotics growth changes our understanding of what it is to be human Virtualisation, Internetisation of life, intelligent Web content Increased surveillance smart security, disruptive surveillance technology big business Progress in nuclear and solar energy is not constraining development Diversification and fragmentation of energy sources (hydrogen, fuel cells and nuclear)
Energy 42	Peak oil  Decentralised power generation	Changing energy source and supply reconfiguring world power division Solar energy meets grid parity	
Ecology Economy 82	Shift in travel patterns due to energy prices and ICT alternatives Increased frequency of economic crises  Capital shift from “W to E” to “E to W”	Increased tensions for R&D ownership Continued rise of Asia as economic, political and military region India and China create increased demand for petrol and minerals Escalation of terrorism and political instability Strategic cyber intrusions attacks shut downs	Solid waste limits industrial activities and life in urban centres Different environmental abuses
Geo-Politics & Security 66	Reversal of globalization and growth of anti-globalization Unsettled global governance in dealing with critical issues Nationalist and nativist backlash prevents the world from realising globalization and migration Disintegration of states, and reintegration in a different format		Increased widespread diseases clue to global warming Increased global unrest related to resource shortage and affordability Water is the oil in the 21st century  Water desalinisation

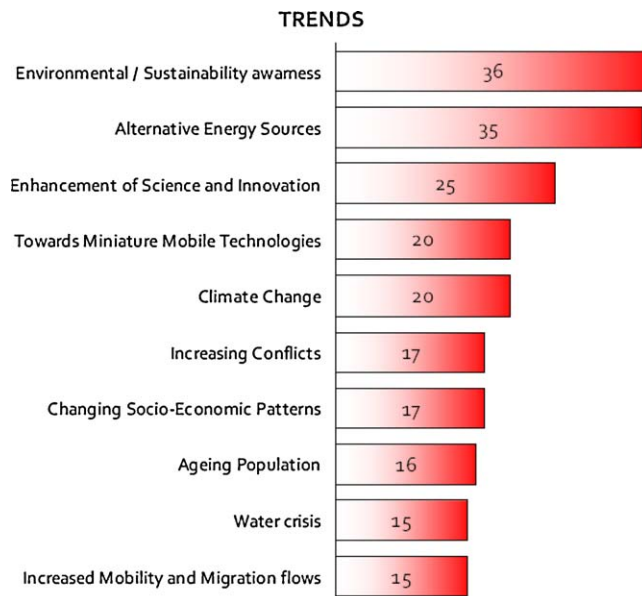


Fig. 5. Frequency distribution of top 10 trends.

years experienced groups. We believe that this strong contribution from the more experienced contributors supports the basic assumption behind the survey – that such a gathering of experts would constitute a uniquely defined relevant cohort worthy of sampling and that they would be motivated by the opportunity to add content ideas additional to their evident Foresight process expertise.

*Impact assessment.* Overall, the respondents considered the impacts of the trends they identified high. Over 70% of the trends identified by the participants have high impact on Society and Culture; Science and Technology; Energy; Ecology and Economy; and Geo-Politics and Security (STEEP). Furthermore, high impact assessment is more prevalent among the more highly experienced respondents (>10 years).

*Likelihood and time horizon assessment.* The majority of the trends were considered to be medium to high probability of occurrence. The respondents stated that over 65% of the trends are likely to occur. The time of occurrence for most of the trends was considered to be from 2016 to 2025. Respondents believe that around 30% of the trends will occur in the short term (before 2015).

*Controversy assessment.* According to the survey respondents the majority of trends identified contain medium to high level possibility of controversy. Assessed together with the time horizon, the survey respondents generally expect that the highest controversies are likely to emerge from 2016 to 2025.

*3.2.2.3. Joint assessment of country of residence and trends.* A majority of the respondents (over 55%) that assessed and contributed trends were from the EU-27 countries. There was a balanced distribution between the respondents from the EU-candidate countries and Australasian countries, which amounted approximately 28% of the respondents, who contributed trends.

*Impact assessment.* The majority of the respondents around the globe considered that more than 75% the trends will have high impact on the STEEP systems. Within the respondents from Australasia and EU Candidate countries the percentage went up to 90%.

*Likelihood and time horizon assessment.* Almost all respondents from all regions considered that there is a medium to high level of occurrence of the trends identified. 75% of the North American respondents considered that the likelihood of occurrence was high, whereas the respondents from Australasia and EU Candidate countries mostly stated a medium likelihood of occurrence for the majority of the trends. The majority of the respondents from Australasia (60%) stated that the trends will occur in the short term (before 2015). More than half of the respondents from North America and the EU countries suggested a medium time horizon (between 2016 and 2025) for the occurrence of the trends identified.

*Controversy assessment.* A majority of the Australasian respondents expect low controversy for the trends identified. The assessment of the respondents from EU Candidate and Associate countries seemed to be the opposite with high controversy expectations. North American and EU respondents considered the level of controversy medium. This distribution and differentiation could be a result of how recent technology challenges such as genetically modified organisms have attracted more intense controversy in Europe than in other regions, and how the EU countries in contrast to the EC Candidate countries have now had the experience and essentially weathered it.

*3.2.2.4. Joint assessment of Foresight affiliation and trends.* A majority of the respondents assessing trends were from Academia (approx. 36%). There was also a significant contribution from the Governmental respondents (over 31%). Low number of respondents from NGOs (0.95%) in trend assessment was noteworthy.

*Impact assessment.* Almost all respondents from different Foresight affiliations stated that over 70% of the trends identified will have high impact on the STEEP systems. No significant differences were observed among different affiliation categories.

*Likelihood and time horizon assessment.* Similarly no significant differences were encountered between the different affiliation category groups. More than 60% of all respondents considered that the likelihood of occurrence of the trends identified will be high. Whereas, the majority of respondents from Academia and NGOs (51% and 58% respectively) considered that the trends will occur between 2016 and 2025, whereas the majority of the respondents from business envisaged shorter time horizon for the emergence of trends (between 2008 and 2015). The responses from the respondents from governments were more balanced between long, medium and short time horizons.

*Controversy assessment.* 52% of the respondents from NGOs expect medium controversy resulting from the trends. The respondents from Academia expect high controversy, whereas the figure is exactly the opposite for the Business respondents, who expect low level of controversy.

### 3.2.3. Drivers of change

The main orientations of the drivers are represented with the following radar diagram.

Analysing the data, the following observations were made (Fig. 6):

- Strong emphasis again on ecology-environment and economy with Society and Culture and S&T close behind;
- Clear belief that health-medicine, climate and the environment will be central to our futures and offer possibilities for improvements, sometimes through dramatic changes;
- Technology improvements are seen to be accelerating and pervasive;
- Infrastructure stress and threats to stability are likely to continue or intensify;
- Personalised, genetic and molecular medicine are likely to drive many changes in health economics, and possible migration of energy sourcing to more efficient and sustainable modes may be available sooner than thought.

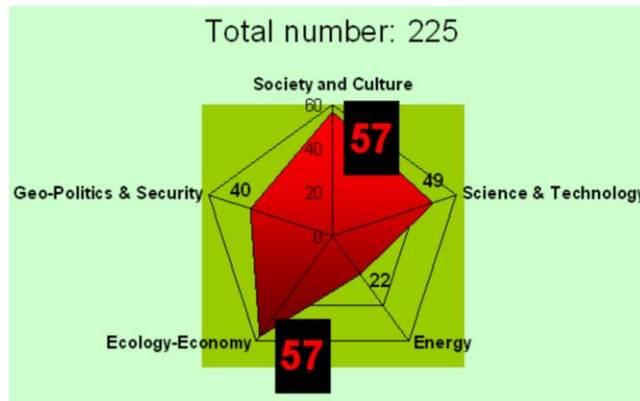


Fig. 6. Orientations of drivers of change.

Fig. 7 shows the frequency distribution of drivers of change and the most widely cited ones.

Table 3 presents some of the critical drivers of change suggested by the respondents.

In contrast to the trends, the drivers are more grounded in current areas of expected leverage such as society-cultural change factors, including R&D and energy choices we may be able to affect through our society or nation. Many of the most articulately described drivers were those associated with the management uncertainties of change in the environmental, governance and globalization response systems. It is probably fair to observe that the drivers lists indicate more optimism and less fatalism than the trends lists, which is consistent with the way that the trends and drivers were defined and differentiated.

3.2.3.1. *Joint assessment of Foresight experience and drivers of change.* A balanced distribution is observed among the respondents with 1–3, 5–10 and over 15 years experience.

*Impact assessment.* Almost all the survey respondents considered that the drivers will have medium to high impact on the STEEP systems with the large majority of the experienced respondents (73%) considered high impact.

*Likelihood assessment.* Similarly, a large number of respondents considered the likelihood of occurrence high for the drivers identified, except the respondents with 10–15 years experience, who considered that about one third of drivers have low probability of occurrence.

*Time horizon.* All respondents from less than 1 year experience to more than 15 years considered that the majority of the drivers will occur between 2016 and 2025.

3.2.3.2. *Joint assessment of country of residence and drivers of change.* Approximately 60% of the drivers were assessed by the EU-27 respondents. Again, a balanced distribution was observed between the EU-candidate countries and Australasian countries.

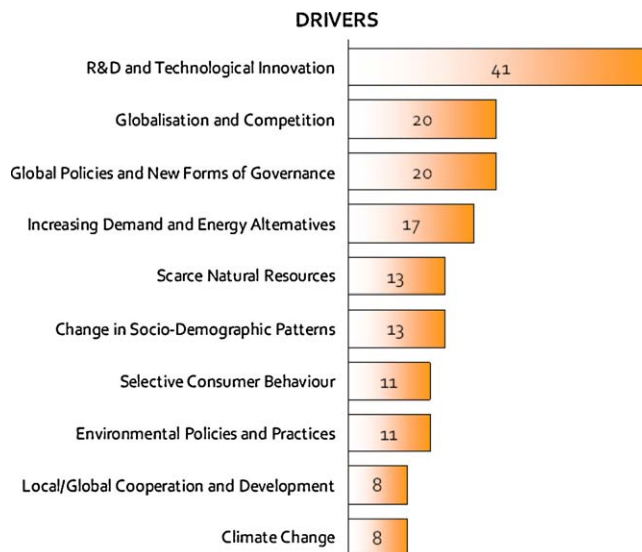


Fig. 7. Frequency distribution of top 10 drivers.

**Table 3**  
Examples of drivers.

	Examples of critical drivers by category		
	A	B	C
Society & Culture 46	Increased citizen participation with the help of collaborative Web tools	International mobility of educated workforce improves cultural competences	Ensuring equity in the development of new technologies
	Self-proficiency and hoarding alters social patterns	Decline of motivation in the youth cohort of industrialised and aging societies	Ethics in capitalism under scrutiny
	Growing tribalism around national, religious and team sport identities	Changes in health risk perception	Ethical investment in development projects to promote sustainability
Science & Tech. 46	Maturation of S, T and Humanities relationship	Increased research in medical science, gene therapy, life prolongation	Technological innovation to create inexpensive self-diagnostic devices
	Development of a global e-science community	The new human: cultural, physical and biological improvements	New investments in the Internet capacity improvement
		Progress in genetic therapy, stem cells and molecular medicine	Sunburst of change in vehicle technology
Energy 17	Rising cost and crises in oil production	Bio-fuel generation	Spread of nuclear energy production toward developing countries
	Lack of energy sources	Innovation for new energy sources which does not effect food chain	
	Increased emphasis on energy conservation		
	Peak oil and climate change lead to descent scenarios		
Ecology Economy 50	Global financial imbalances create national commercial rivalries	China's role in international affairs: perceptions of Chinese elites, and response of the US toward China's growth	Kyoto protocol full implementation
	Political resistance to economic globalization and deregulation	Rising economies demand for energy, electricity drives modernisation and puts extreme stress on infrastructure	Economic measures to meet international environmental commitments
	Growing localisation in response to supply chain vulnerability	Foreign affairs fail to be harmonised to cope with global issues	Patterns of disease radically changed by climate change
Geo-Politics & Security 35	Cooperative and concerted policies among nations	Nuclear proliferation-incidence from terrorism in Middle East	Renewed awareness of the limits to growth
	Uni-bio-multi-polar world	Cyber crime and network vulnerabilities from failure of human systems	Increased barriers to access to natural resources
	Growing organizational and governance incapacity		Water recognised as a valuable resource and priced accordingly

*Impact assessment.* There was a general consensus among all respondents around the globe that around 65% of the drivers will have high impact and the remaining 35% will have medium impact on the STEEP systems. The figures were 75% high and 25% for medium for the Australasian respondents.

*Likelihood and time horizon assessment.* The respondents from North America and the EU countries suggested similar assessments for the likelihood of occurrence of the drivers identified. About half of the drivers identified have high likelihood of occurrence with the rest being medium likelihood of occurrence. The percentages were 63% and 29% respectively for the Australasian respondents. The majority of respondents from the EU member and associate countries and North America considered that around half of the drivers will occur between 2016 and 2025. A considerable percentage of respondents from Australasia suggested that the drivers will emerge in the short run, whereas the majority of the respondents from the EU Candidate countries assessed the time horizon for the occurrence of drivers after 2025.

*3.2.3.3. Joint assessment of Foresight affiliation and drivers.* Respondents from Academia and Government took the lead in drivers assessment with 32% and 25% respectively. More balanced distribution was observed among Business respondents and Students.

*Impact assessment.* Similar to the patterns observed regarding trends, no significant differences were encountered regarding the impact assessment based on Foresight affiliation. The majority of respondents (around 68%) consider that the drivers will have high impact on the STEEP systems, whereas the rest expect medium level of impact.

*Likelihood and time horizon assessment.* The majority of respondents from Academia and NGOs expected a medium level of likelihood of occurrence for the drivers identified. On the contrary, the respondents from Government, Business, and other

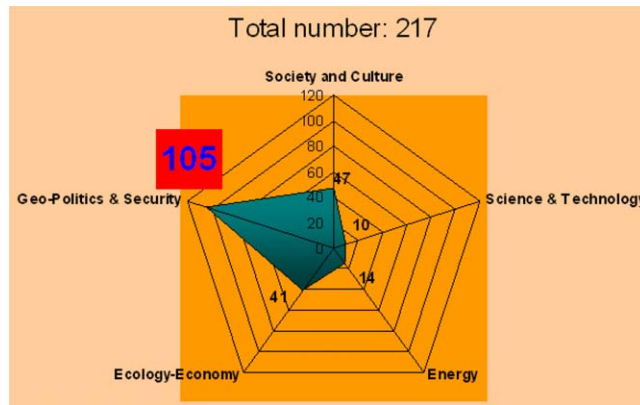


Fig. 8. Orientations of drivers of wild cards/shocks.

affiliations expect high likelihood of occurrence. The majority of the all respondents (around 50%) consider that the drivers will emerge from 2016 to 2025. None of the student respondents expect that the drivers will occur after 2025.

### 3.2.4. Wild cards/shocks

The radar diagram, Fig. 8 below shows the orientations of the 217 wild cards/shocks identified.

The following observations were made from the analysis of wild cards/shocks:

- High number of imaginative and creative responses – 217 in total;
- Clear dominance of geo-politics and security – not a surprise – but followed by Society and Culture – some interesting possibilities;
- Many shocks for some were treated as drivers or trends by others – i.e. displaying quite a wide range of attitudes and beliefs, confidence levels in the ability of existing systems to adapt;
- Usual suspects (natural disaster, nuclear accidents, etc.) supplemented by several provocative shifts in human psyche, social cohesion factors, ethics, etc.;
- Global order–disorder and natural health and shocks affecting the resilience of Planet Earth are recurring themes treated in many different ways;
- Suggest the possibility of probing deeper in subsequent surveys to extract a more complete picture of the provocative edge.

Fig. 9 illustrates the frequency of wild cards/shocks identified and the most widely cited ones.

Table 4 shows the examples of wild cards/shocks by category.

Natural and global sourced major disasters and events originating in the geo-political arena of conflict, wars, terrorism and competition for scarce resources dominate as expected here. Some of the more interesting prospective wild cards

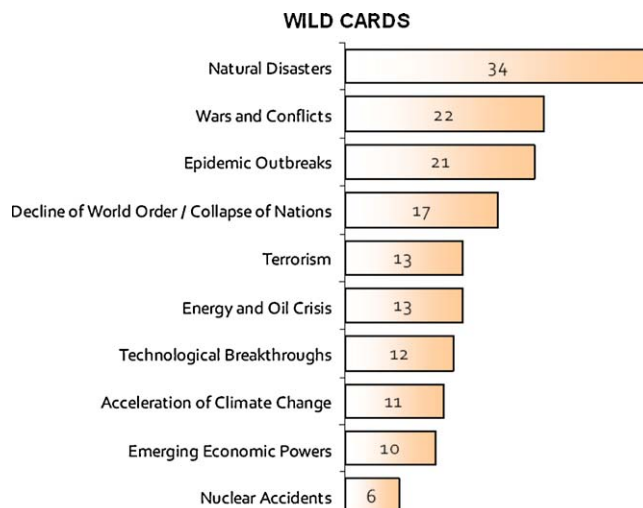


Fig. 9. Frequency distribution of top 10 wild cards/shocks.

**Table 4**  
Examples of wild cards/shocks.

	Examples of wild cards–shocks by category		
	A	B	C
Society & Culture 42	Rise of dogma, e.g. creativism/creationism, social resistance to technological change  Strong classes between cultures, intensification of conflicts between cultural classes Decline of knowledge grounded in local society and history because of less direct human interaction	New diseases from pharmaceutical and space research  Population boom & high competition in job markets  Blockage of free trade due to a major pandemic	Intolerance of science to renew moral outrage over genetic modification, trans-humanist research, etc.
Science & Tech. 9	Big disasters in science, creation of out-of-control species, viruses, robots Shocking scientific discovery challenges all hitherto received ideas, e.g., interrestrial visitors, alliance, eco-collapse, bio-tech New S&T paradigms for knowledge society and people well being	Disruption of technological systems  Increased impact of converging technologies on social life	Artificial intelligence passes human capacity  Natural language codifications becomes available allowing people communicate globally  Human–animal communication
Energy 12	New transportation based on new types of flying cars on hydrogen change all traffic patterns Regression in the development because of mismanagement of energy sources Peak oil and climate shifts decisively confirmed meaning to rapid shift to alternatives	Nano thin film solar breakthroughs allow energy production from all surfaces fading the sun	Successful nuclear fusion shifts energy to electricity and hydrogen  Hydrogen from LG means pervasive bio-hydrogen production possible
Ecology Economy 32	Global trade conflicts intensify between developed and developing countries G8 support equitable redistribution of wealth to enable the achievement of millennium development goals Massive failure of capitalism and liberal democracy	Civil war in China  New Islamic superpower  Iran nukes Israel	Unexpected freeze of northern hemisphere pushes population to immigrate south Rapid climate change overwhelms human capacity  Global warming turns out to be a false prediction due to misunderstanding of causes
Geo-Politics & Security 89	Declining world order and uncontrolled proliferation of corruption, crime and pollution Millions of weather related refugees disrupt global system Accidental nuclear spasm leads to war	Total satellite failure interconnectivity black out  Religion-based World War  Terrorist attacks create police states	More frequent natural catastrophies divert resources from development  Change of earth rotation causes climate change Global disasters from alignment of volcanoes, tsunamis, earthquakes, typhoons, droughts, etc.

include those identified in Table 4 that would have unknown implications because of they were to appear, could fundamentally change the ways some familiar and long surviving societal systems. Again, to be able to embody there types of wild cards into some scenarios could be a provocative and rewarding exercise to test some of the leverage points that may impact change if any of these eventually emerge.

*3.2.4.1. Further assessment of wild cards/shocks by time horizon, affiliation and country of residence. Experience × time horizon.* As the years of experience increased, the time horizon for the occurrence of wild cards tended to remain between 2016 and 2025. Respondents with no experience expected that the wild cards would occur after 2025, whereas the respondents with maximum 3 years of experience had a shorter time horizon (2008–2015).

*Affiliation × time horizon.* Regarding the affiliation of participants, the time of occurrence for wild cards indicates parallelism between the respondents from Academia, Business and Other affiliations, who have a medium term time horizon. While the time horizon for students and NGO respondents is longer, it is the opposite for the participants from the Government, where the majority (40%) has a shorter time horizon for the occurrence of wild cards.

*Country of residence × time horizon.* Respondents from the EU Candidate countries have a longer time horizon, compared to the respondents from the rest of Europe. The respondents from North America have a more balanced distribution of time horizons among short, medium and long terms.

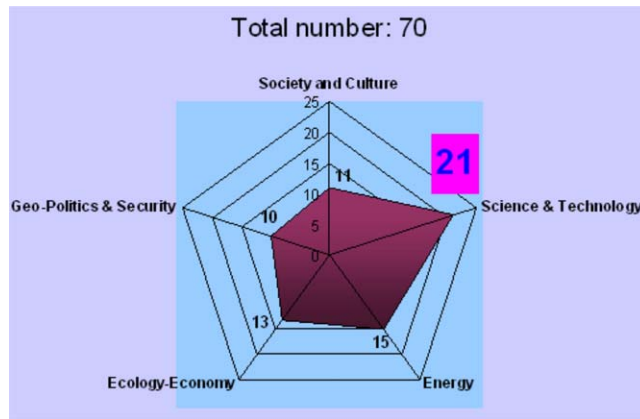


Fig. 10. Orientations of discontinuities.

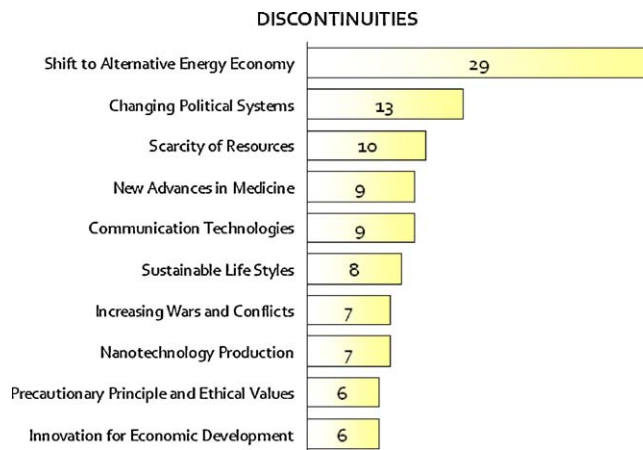


Fig. 11. Frequency distribution of top 10 discontinuities.

### 3.2.5. Discontinuities

The orientations of discontinuities are represented with the following radar diagram (Fig. 10). The discontinuities observations include:

- Respondent fatigue and lack of differentiation evident in reduced response total – 70;
- Distribution – toward S&T and energy is different from previous categories;
- Good range of trigger events and situations;
- Energy, resource and environmental breakthroughs are included which provide a positive outlook as well as more familiar negative discontinuities;
- Some interesting prospective reversals of current – conventional opinions.

The frequency distribution of discontinuities and the most widely cited ones are in Fig. 11.

Some of the striking discontinuities are shown in Table 5.

Discontinuities with respect to fairly rapid shifts in energy systems, sources and climate-resources management represent the most frequently cited domains, with the next area being new governance models. Overall, the lists provide a fertile field for some real dramatic change scenarios centred on some key discontinuities. While these lists are still innovative and worthy of more focused analysis by specialists, the strong alignment of these factors with those already cited as drivers and shocks (or possibly showing a respondent fatigue pattern) suggests that it may be important to analyse the patterns of individual responses to see how they differentiate among the key factors and whether any of the sorting base descriptions (i.e. age, affiliation, years of experience and country of origin) demonstrates particular significance with respect to the differentiation and sophistication of responses.



**Table 5**  
Examples of discontinuities.

	Examples of discontinuities by category		
	A	B	C
Society & Culture 10	Back to basics: nature, safety, home	Personalised genomic healthcare	Rapid reversal of tolerance to multicultural populations “Enhanced Olympics” – all enhancements, all drugs allowed
Science & Tech. 13	Human systems adapt to new culture of physical and biological requirements	Reduced need for health services	All communications are mobile, Web-based and wireless changing human settlements Nanotechnology radically changes production methods and material world via molecular and self-assembling entities Business and social environments revise to accommodate Wiki, Facebook, You Tube, etc. Technical breakthrough in electric energy storage Breakthrough in hydrogen production methods require infrastructure requirements Nano-facilitated energy conversion alters energy economic mix
	Human decisions change because of the Internet advisory capacity	Slow down in the world population from development	
	Scientific community discredited, isolated and ostracised	Accelerated ICT development in ubiquitous computation	
Energy 13	E-science, virtual science discredited for unreliable biased data	Biochips for human implants	Runaway global warming Accelerated arctic ice shelf melting push international climate treaties Rising sea levels prompt large infrastructure restructuring Nanotechnology and ecological behaviour reverse perception of a resource scarce world Resource scarcity creates new motivations for space resource discovery/extraction
	Secularism in science overvalues in religion	End of Moore’s law	
	Energy availability increases plentiful oil and other alternatives Sudden stop of research into renewable and alternative energy sources Massive failure of airlines because of oil price increase causes travel decline	Rapid advances in concentrated solar energy New cost-effective sources of renewable energy identified	
Ecology Economy 7	Western world becomes a national/corporate welfare state Increase of poverty	BRICS rapidly overtake western economy China leads world in green and renewable energies	
Geo-Politics & Security 8	Europe becomes the most competitive economy in the world	WW3	
	Discontinuities in national and international policy approaches toward climate change	Breakdown of world order	
	Conflicts between treaty promoters and deniers create discontinuity	Global security issues rise, e.g. nuclear crisis	

3.2.5.1. *Joint assessment of Foresight experience and discontinuities.* Over 33% of the discontinuities were defined by the respondents with over 15 years experience. Respondents with 5–10 years experience also contributed significantly (over 27%).

*Impact assessment.* The majority of the drivers identified were identified as likely to have high impact on the STEEP systems with the rest of the drivers (approximately a quarter of them) likely to have medium impact.

*Likelihood and time horizon assessment.* The likelihood of occurrence for about 50% of the discontinuities identified was considered to be medium. Different from the other groups, respondents with 5–15 years experience considered that more than 50% of the discontinuities will occur with the realisation time between 2016 and 2025. Inexperienced respondents (<1 year) considered that most of the discontinuities will be observed in the short run (before 2015), whereas the most experienced respondents expect that the discontinuities will occur in the medium run (2016–2025).

3.2.5.2. *Joint assessment of country of residence and discontinuities.* Over 60% of the respondents assessed discontinuities were from the EU-27 countries. The candidate country respondents constituted the second largest group.

*Impact assessment.* The impacts of the discontinuities identified were considered to be high by most of the respondents around the globe. The figure went as high as 75% among the North American respondents.

*Likelihood and time horizon assessment.* Strong disagreements were observed regarding the likelihood of occurrence of the drivers identified. The majority of the respondents from the US (54%) considered low likelihood of occurrence for discontinuities. The figure was opposite for the EU member countries, where most of the respondents (46%) considered high likelihood of occurrence for the discontinuities. On the other hand 67% of the respondents from Australasia considered the likelihood of occurrence medium. 45% of North American respondents expect that the discontinuities will occur after 2025, whereas most of the EU member country respondents suggest that the discontinuities will emerge between 2016 and 2025. A strong consensus is observed among the Australasian respondents that the majority of the discontinuities will occur from

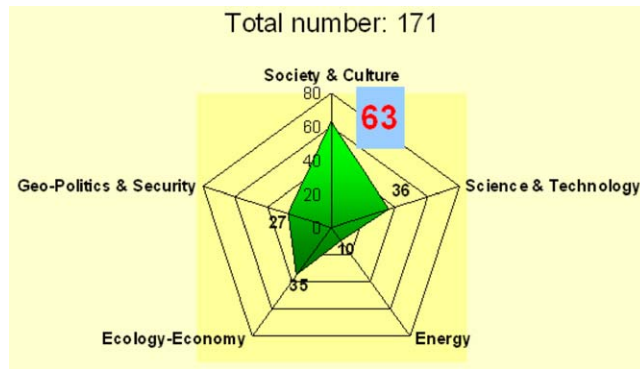


Fig. 12. Orientations of weak signals.

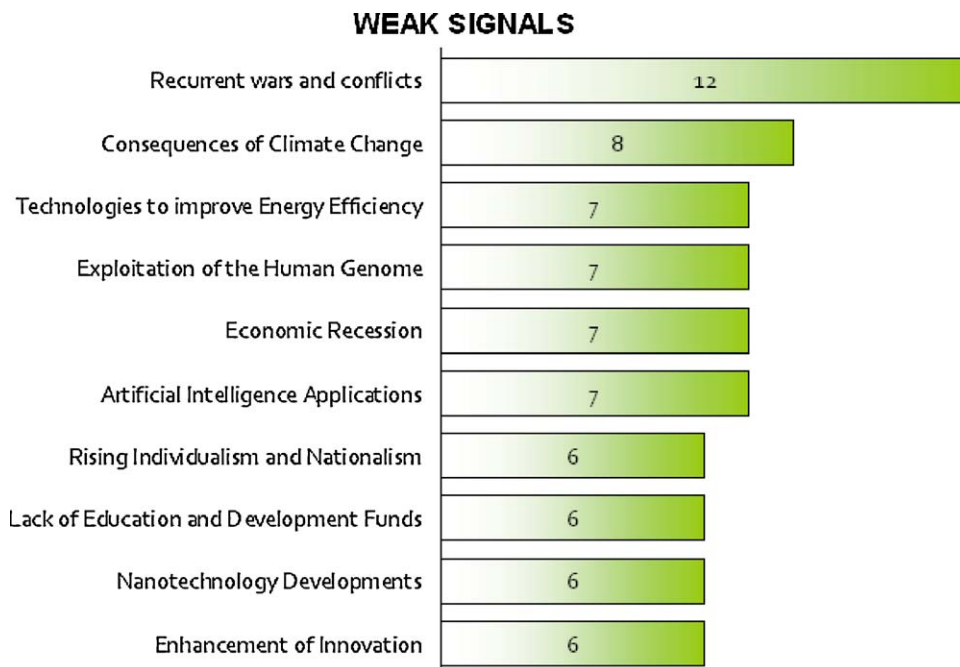


Fig. 13. Frequency distribution of top 10 weak signals.

2016 to 2025. These differences suggest some further survey or focus group opportunities to probe the differences in perception of discontinuities.

3.2.5.3. *Joint assessment of Foresight affiliation and discontinuities.* Again, Academic respondents took the lead in the assessment of the discontinuities (39%). A high and balanced participation in discontinuity assessment was observed among the Governmental and Business respondents.

*Impact assessment.* Around 70% of all respondents from various Foresight affiliations that assessed discontinuities expect high impact. The rest of the respondents stated medium impact.

*Likelihood and time horizon assessment.* Regarding the likelihood of occurrence of discontinuities, the responses from Academia, NGOs and Students were identical, where about 52% of the respondents suggested medium level of likelihood. 50% of the respondents from Government and Business stated high likelihood of occurrence. The figures changed slightly in the assessment of time horizons. This time Academia and Business suggested that most of the discontinuities would emerge from 2016 to 2025, whereas students and Governmental respondents expected a longer time horizon (beyond 2025).

### 3.2.6. Weak signals

The radar diagram below (Fig. 12) shows the orientations of the 171 weak signals identified by the respondents of the Big Picture Survey.

The following observations were made after the analysis of the Weak signals:

**Table 6**  
Examples of weak signals.

	Examples of weak signals by category		
	A	B	C
Society & Culture 61	Concept of rational behaviour in modernity losing value and impact  Stronger impact of artists  Dependence on anti-factual information, failing roots of knowledge and understanding	People might be eating plastics due to photo-degraded plastics in environments (e.g. eaten by fish) Increase of genetic and hereditary diseases Declining male fertility	Different ethical vision science built  Acceptance of new culture in arts, architecture, law and life styles Human cloning
Science & Tech. 33	Ubiquitous connectivity – web 2.0, Facebook, second life. “Lag of the real behind the virtual” Freedom to do any type of research  Researchers become entrepreneurs	Bio-tech revolution and robotics change human race  Breakthrough in plant gene to create antibiotics for cancer Exploitation of other planets and moon Solar energy price descants	Less usage of human brain  Nano membranes allow humans swim under water without air tubes Rights to robots
Energy 9	Russia turns off gas/oil for political purposes Wrong prediction of oil prices by IEA		Shift to hydrogen energy
Ecology Economy 27	Widening the rift between rich and poor Price hikes in energy, materials and food Privatisation criticised more	More rights of China  Democratisation of China  China implodes due to several political conflicts	Induced migration due to inundation and climate change Sunspot theory of climate change  Diverse opinions on environmental issues
Geo-Politics & Security 26	Independent regions in Europe  Liberal counter-revolution in Iran  Integration process of Asia and Africa	Marginalised proponents of terrorism Increased technological pressure to redefine confidentiality – loss of privacy Technologies out of control	Geopolitical conflict over fisheries and water resources Global food supply shortage  Changes in the gravity of the earth

- Good response with 171 weak signals;
- Lots of focus on Society and Culture = a well balanced orientation for a FTA audience;
- Provocative elements explored: tipping points in culture, science and ecology; familiar bases for economic value, international conflict and innovations may be shifting – resulting in loss of control by the old guard actors;
- New ethics, new freedoms, new rights and technologies out of control are cited;
- Also worthy of deeper probing in subsequent surveys.

Fig. 13 shows the frequency distribution of weak signals identified by the survey respondents and the most widely cited ones.

Table 6 gives the examples of weak signals by category.

Compared to the previous elements, the distribution of weak signals appears to be more balanced and nuanced in terms of socio-cultural variables, but more definitive in terms of technological and ecological signals. In many areas, the weak signals – if and when they become strong – will signify real shifts toward new and somewhat uncharted directions for societies – hence they represent a good cross section of global anxieties as well as global aspirations – great fodder for an extended strategic conversation.

*3.2.6.1. Further assessment of weak signals by time horizon, affiliation and country of residence. Experience × time horizon.* The respondents with a Foresight experience longer than 1 year expect most the majority of the weak signals to emerge in the medium term future (2016–2025), whereas the inexperienced respondents have a longer time horizon (beyond 2025). This is likely due to the familiarity that older and more experienced contributors have with how fast changes can really appear from insight to application.

*Affiliation × time horizon.* The majority of the Business respondents have a longer term time horizon (beyond 2025) compared to the respondents from Academia and Governments who consider that most of the weak signals will occur in the mid-term (2016–2025).

*Country of residence × time horizon.* Regardless the country of residence most of the respondents have medium term time horizon, with a higher emphasis from the EU Associate countries.

#### 4. Conclusions and implications on policy and strategy

The following implications from the outputs of the Big Picture Survey can be mentioned:

- The survey responses provide a rich and diverse array of issues that cover most of the provocative policy issues now engaging public debate and offer a new set of prospective future issues as well;
- The range and tone of these policy relevant topics is certainly very wide, reflecting perhaps more what might go wrong rather than seeing possible developments as opportunities or situations that could become positive in a new context;
- For the most part, the drivers in particular suggest an adequate number of critical uncertainties and polarities so that scenarios development appears to be both possible and desirable;
- Overall the many obviously very thoughtful responses and the depth and scope of imaginative thinking inherent in these responses suggest a robust series of discussions and further research and scenarios development may be warranted;
- Further assessment of survey variables has indicated that there are no dramatic surprises, but there seem to be emerging several instances of avenues that could benefit from further discussion, focus groups or another survey that invites respondents to elaborate upon their choices.

The results reveal that the data is both useful and quite insightful and diverse. More data and analysis will be required to fully develop the potential of this survey – but an excellent base now exists, one that could provoke a more consistent and comprehensive response over time.

The current paper aims to establish a methodological base. The authors acknowledge that it could benefit from additional content assessment. However, subsequent work will concentrate more on the interpretation of the rich data set that has been acquired and will be augmented. A first, but a limited attempt at further interpretation of the BPS data has already been made by using social network analysis in a paper by Nugroho and Saritas [17]. Another paper dedicated to a further elaboration of the BPS results is planned by the authors in 2009.

Given that this was a first iteration, another limitation became evident regarding the definition of the boundaries regarding the STEEP categories. This classification was made by the authors to manage the high number and diverse nature of the responses. Some responses were very precise and some were very general and consequently distribution could be different depending on the interpretation, i.e. which categories to assign general responses to.

Overall, the authors are very pleased with the response even though time did not permit a full analysis of the data. Further analysis will include: (1) trends and drivers by experience, country of residence and affiliation and also by responses on impact, likelihood, controversy and horizon time; (2) discontinuities, wild cards and weak signals by a similar but smaller range of differentiators. There may be some surprises or patterns or just: **so what!** So wait for the next iteration in 2010.

In summary, the authors are excited by how this information might be further dissected and examined for themes and insights that can be used to guide future Foresight work and additional FTA surveys of this type or building upon this base. Our primary conclusion is that it will be very useful to repeat the survey with FTA 2010 if possible, and extend it to other similar groups, in the next year or two, for comparison purposes.

#### Acknowledgement

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